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FINAL SUPPLEMENT ENVIRONMENTAL IMPACT STATEMENT

Waste Isolation Pilot Plant

Executive Summary

January 1990

U.S. DEPARTMENT OF ENERGY
Office of Environmental Restoration
and Waste Management

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Office of Environmental Restoration
and Waste Management
Washington, D.C. 20585

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COVER SHEET

RESPONSIBLE AGENCIES:

Lead Agency: U.S. Department of Energy (DOE)
Cooperating Agency: U.S. Department of the Interior, Bureau of Land Management (BLM)

TITLE:

Final Supplement, Environmental Impact Statement, (SEIS), Waste Isolation Pilot Plant (WIPP)

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ABSTRACT:

In 1980, the DOE published the Final Environmental Impact Statement (FEIS) for the WIPP. This FEIS analyzed and compared the environmental impacts of various alternatives for demonstrating the safe disposal of transuranic (TRU) radioactive waste resulting from DOE national defense related activities. Based on the environmental analyses in the FEIS, the DOE published a Record of Decision in 1981 to proceed with the phased development of the WIPP in southeastern New Mexico as authorized by the Congress in Public Law 96-164.

Since publication of the FEIS, new geological and hydrological information has led to changes in the understanding of the hydrogeological characteristics of the WIPP site as they relate to the long-term performance of the underground waste repository. In addition, there have been changes in the information and assumptions used to analyze the environmental impacts in the FEIS. These changes include: 1) changes in the composition of the TRU waste inventory, 2) consideration of the hazardous chemical constituents in TRU waste, 3) modification and refinement of the system for the transportation of TRU waste to the WIPP, and 4) modification of the Test Phase.

The purpose of this SEIS is to update the environmental record established in 1980 by evaluating the environmental impacts associated with new information, new circumstances, and proposal modifications. This SEIS evaluates and compares the Proposed Action and two alternatives.

The Proposed Action is to proceed with a phased approach to the development of the WIPP. Full operation of the WIPP would be preceded by a Test Phase of approximately 5 years during which time certain tests and operational demonstrations would be carried out. The elements of the Test Phase, tests and operations demonstration, continue to evolve. These elements are currently under evaluation by the DOE based on comments from independent groups such as the Blue Ribbon Panel, the National Academy of Sciences, the Environmental Evaluation Group, and the Advisory Committee on Nuclear Facility Safety. At this time, the Performance Assessment tests would be comprised of laboratory-scale, bin-scale, and alcove-scale tests. The DOE, in December 1989, issued a revised draft final Test Phase plan that focuses on the Performance Assessment tests to remove uncertainties regarding compliance with long-term disposal standards (40 CFR 191 Subpart B) and to provide confirming data that there would be no migration of hazardous constituents (details are available in Subsection 3.1.1.4 and Appendix O). The tests would be conducted to reduce uncertainties associated with the prediction of natural processes that might affect long-term performance of the underground waste repository. Results of these tests would be used to assess the ability of the WIPP to meet applicable Federal standards for the long-term protection of the public and the environment. The operational demonstrations would be conducted to show the ability of the TRU waste management system to certify, package, transport, and emplace TRU waste in the WIPP safely and efficiently. Waste requirements for the Integration Operations Demonstration remain uncertain. A separate document would be developed to describe in detail the Integration Operations Demonstration following the DOE's decision as to the scope and timing of the demonstration.

During the Test Phase, National Environmental Policy Act (NEPA) requirements would be reviewed in light of the new information developed and appropriate documentation would be prepared. In addition, the DOE will issue another SEIS at the conclusion of the Test Phase and prior to a decision to proceed to the Disposal Phase. This SEIS will analyze in more detail the system-wide impacts of processing and handling at each of the generator/storage facilities and will consider the system-wide impacts of potential waste treatments.

Upon completion of the Test Phase, the DOE would determine whether the WIPP would comply with U.S. Environmental Protection Agency (EPA) standards for the long-term disposal of TRU waste (i.e., 40 CFR Part 191, Subpart B; 40 CFR Part 268). The WIPP would enter the Disposal Phase if there was a favorable Record of Decision based on the new SEIS to be prepared prior to the Disposal Phase and if there was a determination of compliance with the EPA standards and other regulatory requirements. During this phase, defense TRU waste generated since 1970 would be shipped to and disposed of at the WIPP. After completion of waste emplacement, the surface facilities would be decommissioned, and the WIPP underground facilities would serve as a permanent TRU waste repository.

The first alternative, No Action, is similar to the No Action Alternative discussed in the 1980 FEIS. Under this alternative, there would be no research and development facility to demonstrate the safe disposal of TRU waste, and TRU waste would continue to be stored. Storage of newly generated TRU mixed waste would be in conflict with the Resource Conservation and Recovery Act (RCRA) Land Disposal Restrictions; treatment would be required to avoid such conflict. The WIPP would be decommissioned as a waste disposal facility and potentially put to other uses.

The second alternative to the Proposed Action is to conduct the bin-scale tests at a facility other than the WIPP and to delay emplacement of TRU waste in the WIPP underground until a determination has been made of compliance with the EPA standards for TRU waste disposal (i.e., 40 CFR Part 191, Subpart B). The bin-scale tests could be conducted outside the WIPP underground facilities in a specially designed, aboveground facility. The implications of this alternative include delays in both the operational demonstrations and alcove-scale tests, the lack of alcove-scale test data for the compliance demonstration, and placing the WIPP facilities in a "standby" mode. The specialized facility for aboveground bin-scale tests could be constructed at any one of the DOE facilities. In order to analyze the environmental impacts of this alternative in the final SEIS, the DOE has evaluated the Idaho National Engineering Laboratory in Idaho as a representative facility for the aboveground bin-scale tests.

ADDITIONAL INFORMATION:

The 1980 FEIS was reprinted and provided to the public with the draft SEIS which was published April 21, 1989. Public comments on the draft SEIS were accepted for a period of 90 days after publication. During that time, public hearings were conducted in Atlanta, Georgia; Pocatello, Idaho; Denver, Colorado; Pendleton, Oregon; Albuquerque, Santa Fe and Artesia, New Mexico; Odessa, Texas; and Ogden, Utah.

This final SEIS for the WIPP project is a revision of the draft SEIS published in April 1989. It includes responses to the public comments received in writing and at the public hearings and revisions of the draft SEIS in response to the public comments. Revisions of importance have been identified in this final SEIS by vertical lines in the margins to highlight changes made in response to comments.

Volumes 1 through 3 of the final SEIS contain the text, appendices, and the summary comments and responses, respectively. Volumes 6 through 13 of the final SEIS contain reproductions of all of the comments received on the draft SEIS, and Volumes 4 and 5 contain the indices to Volumes 6 through 13. An Executive Summary and/or Volumes 1 through 5 of the final SEIS have been distributed to those who received the draft SEIS or requested a copy of the final SEIS. Although not distributed to all who commented on the draft SEIS, Volumes 1 through 13 of the final SEIS have been placed in the reading rooms and libraries listed in Appendix K; these volumes will be mailed to the general public upon request.

A notice of availability of the final SEIS has been published by the EPA in the Federal Register. The DOE will make a decision on implementation of the Proposed Action or the alternatives no earlier than 30 days after publication of the EPA notice of availability. The DOE's decision will be documented in a publicly available Record of Decision to be published in the Federal Register and distributed to all who receive this final SEIS.

Foreword

In October 1989, the Secretary of Energy issued a draft Decision Plan for the Waste Isolation Pilot Plant (WIPP). The Decision Plan listed all key technical milestones and institutional activities for which Departmental, Congressional, or State actions are required prior to receipt of waste for the proposed Test Phase, which is the next step in the phased development of the WIPP. The Plan was issued for review to States, Congressional representatives, other Federal agencies (including the Environmental Protection Agency and the Department of the Interior), and oversight groups (e.g., the Advisory Council for Nuclear Facility Safety, the Blue Ribbon Panel, the National Academy of Sciences, and the Environmental Evaluation Group). Revision 1 of the Plan was issued in December 1989.

Departmental activities required prior to receipt of waste at the WIPP include completion of the "as-built" drawings for the facility, the Energy Systems Acquisition Advisory Board review process, waste-hoist repairs, preoperational appraisal and operational readiness review, mining and outfitting of the alcoves for the proposed Test Phase, and completion of this Supplement to the Environmental Impact Statement.

Other Departmental activities include completion of the Final Safety Analysis Report (FSAR) and issuance of the FSAR addenda to address the proposed Test Phase and associated waste retrieval (if necessary). Future Departmental activities include the planned issuance of the EPA Standards Compliance Summary Report and the evaluation of waste form treatments and design modifications that may be required to meet the EPA Subpart B disposal standards.

Key activities involving oversight groups include final development of an acceptable retrievability program to demonstrate that waste emplaced during the first five years of the facility operation are fully retrievable, and an integrated waste handling demonstration using simulated wastes to ensure system-wide readiness for receipt of wastes for the Test Phase.

Institutional activities include concurrent pursuance of legislative and administrative land withdrawal (legislative withdrawal is the process preferred by the Department); the EPA's ruling on the DOE's No-Migration Variance Petition in compliance with the Land Disposal Restrictions under the Resource Conservation and Recovery Act (RCRA); resolution of regulatory issues, including the State of New Mexico's authority to regulate mixed waste under the RCRA and the designation of routes to be used for transport of transuranic waste; Departmental resolution of any mineral lease at the WIPP; and completion of appropriate agreements with the Western Governors Association and Southern States Energy Board.

This Supplemental Environmental Impact Statement (SEIS) is one of a number of milestones which are critical to the opening of the Waste Isolation Pilot Plant. This SEIS provides an upper bound of the potential impacts of the Proposed Action and alternatives. Based on this final SEIS, the Department will issue a Record of Decision no sooner than 30 days after the EPA publishes a notice of availability in the Federal Register.

TABLE OF CONTENTS

Page

COVER SHEET iii

FOREWORD vii

TABLE OF CONTENTS ix

INTRODUCTION S-1

BACKGROUND S-1

REASONS FOR PREPARING A SEIS S-2

MAJOR ISSUES RAISED IN COMMENTS AND REVISIONS S-5

Programmatic issues and the scope of the SEIS S-5

Compliance with EPA regulations and RCRA requirements S-6

Waste volumes and characteristics S-6

Waste retrieval S-6

Transportation S-6

Operational safety and long-term performance S-7

DESCRIPTION OF ALTERNATIVES S-8

Proposed Action S-8

No-Action Alternative S-9

Alternative Action S-10

Alternatives considered but not analyzed S-10

EXISTING ENVIRONMENT S-11

Page

ENVIRONMENTAL CONSEQUENCES S-11

Retrieval and Processing S-11

Transportation S-11

Operations/Retrieval S-13

Socioeconomic Effects S-13

Long-term Performance S-14

Integrated releases S-15

MITIGATION MEASURES S-16

LIST OF TABLES

Table Page

S-1 Summary and comparison of environmental consequences S-18

INTRODUCTION

The U.S. Department of Energy (DOE) has prepared this final Supplemental Environmental Impact Statement (SEIS) for the Waste Isolation Pilot Plant (WIPP) to assess the potential impacts of continuing the phased development of the WIPP as a geologic research and development facility to demonstrate the safe disposal of post-1970 defense generated transuranic (TRU) waste. A 1981 Record of Decision, based on the 1980 Final Environmental Impact Statement, documented the DOE's decision to proceed with the phased development of the WIPP at a site near Carlsbad, New Mexico. TRU wastes are materials contaminated with alpha-emitting radionuclides that are heavier than uranium and have half-lives longer than 20 years at concentrations higher than 100 nanocuries per gram of waste. Since 1970, these wastes have been stored separately from other radioactive wastes in a manner that allows them to be retrieved. These wastes are generated and/or stored by 10 DOE defense facilities around the country.

BACKGROUND

The WIPP site is located in Eddy County in southeastern New Mexico. It is about 26 miles southeast of Carlsbad in an area known as Los Medanos ("the dunes"), a relatively flat, sparsely inhabited plateau with little surface water and limited land uses. The land is used mainly for grazing, but other uses in the area include mining for potash and oil-and-gas exploration and development. The WIPP site can be reached by rail or highway.

The WIPP was authorized by Public Law 96-164 to provide a research and development facility for demonstrating the safe disposal of radioactive wastes produced by national defense activities. The DOE's decision to proceed with the WIPP project at a location in southeastern New Mexico followed a thorough review in accordance with NEPA and was announced in a Record of Decision (January 1981). The decision called for the phased development of the WIPP for the disposal of post-1970 TRU wastes. The WIPP facility was designed to dispose of approximately 6.2 million cubic feet (ft^3) of contact-handled (CH) TRU waste and 250,000 ft^3 of remote-handled (RH) TRU waste in the 100-acre mined repository over a 25-year operational life.

The major construction activities at the WIPP are nearly complete; surface facilities are essentially complete, and most of the underground rooms for experimentation and for initial waste emplacement have been excavated. The principal surface structure at the WIPP is the Waste Handling Building, in which TRU wastes would be received, inspected, and moved to a waste-handling shaft for transfer underground. The building also contains change rooms, a health-physics laboratory, and equipment for ventilation and filtration. Other surface facilities include a water pumphouse, a sewage-treatment plant, a building for safety and emergency services, a guard and security building, and warehouses.

The constructed underground facilities include four shafts, the waste disposal area, an experimental area, an equipment and maintenance area, and connecting tunnels. These underground facilities were mined in the Salado Formation 2,150 feet beneath the land surface.

The TRU wastes that would be emplaced at the WIPP result primarily from plutonium reprocessing and fabrication, as well as research and development activities at various DOE facilities. The wastes exist in a variety of forms ranging from unprocessed laboratory trash (e.g., tools, glassware, and gloves) to solidified sludges from waste water treatment. TRU wastes are classified, for purposes of handling at the WIPP, according to the radiation dose rate at the waste package or container surface.

About 60 percent of these TRU wastes also contain hazardous chemical components. TRU wastes containing hazardous chemical components are similar in their physical and radiological characteristics to those of TRU wastes that do not contain chemicals. A major chemical component is metallic lead, which is present mainly in the form of glovebox parts and lead-lined gloves and aprons. Some waste types contain traces of organic solvents (e.g., methylene chloride, carbon tetrachloride) used in cleaning equipment, plastics, and glassware.

REASONS FOR PREPARING A SEIS

Since the publication of the FEIS in October 1980, new data collected at the WIPP site have led to changes in the understanding of the hydrogeologic characteristics of the area and their potential implications for the long-term performance of the WIPP. In addition, there have been changes in the FEIS Proposed Action and new regulatory requirements. This supplement to the FEIS evaluates the environmental consequences of the Proposed Action as modified by changes since 1980 and in light of new information.

The principal changes that are addressed in this SEIS are as follows:

- Changes in the volume of the TRU wastes. In 1980, the WIPP was designed to accommodate approximately 6.2 million ft^3 of CH TRU waste and 250,000 ft^3 of RH TRU waste. Recent estimates are that approximately 5.6 million ft^3 of CH TRU waste and 95,000 ft^3 of RH TRU waste are in retrievable storage or would be newly generated during the operational period of WIPP (2013) at the 10 DOE generator/storage facilities from which wastes may ultimately be emplaced at WIPP. Nonetheless, the impacts assessment in this SEIS are based on the 1980 design capacity in order to establish an upper limit on the potential impacts of disposal.

- Changes in the composition of the TRU-waste radioactivity inventory. In 1980, high-curie and high-neutron wastes were not considered; the inventory evaluated in this SEIS includes such wastes.

- Elimination of experiments using high-level wastes. In 1980, experiments with high-level wastes were proposed; such experiments are no longer under consideration.

- Consideration of the hazardous chemicals in the TRU waste. In 1980, the impacts of the hazardous chemical component of TRU waste were not analyzed. It is now estimated that about 60 percent of the TRU waste that may be emplaced in the WIPP contains hazardous components (chemicals) or exhibits hazardous characteristics as defined by the RCRA. The hazardous components, however, account for only a small fraction of the total waste volume and consist mainly of metallic lead from radiation shielding and trace quantities of spent organic solvents.

- Change in the modes of transportation. In the 1980 FEIS, it was assumed that 75 percent of the waste shipments to the WIPP would be made by train and 25 percent by truck. This SEIS considers all-truck transport and an alternative "maximum" rail transport mode in which trains would be used for transport from eight facilities and trucks would be used for transport from the two facilities that have no railheads. The use of all-truck transportation is currently proposed for the Test Phase; the train option could be used during the Disposal Phase.

- Change in the waste transport packaging. The design of the transport packaging for CH TRU has changed from a vented, single containment packaging (TRUPACT-I) in 1980 to a non-vented, doubly contained packaging (TRUPACT-II) whose design has been certified by the Nuclear Regulatory Commission.

- A modified Test Phase. It is proposed to conduct a modified Test Phase of approximately 5 years. The technical focus of the Test Phase is to 1) reduce uncertainties associated with factors that may affect repository performance such as gas generation and brine inflow and 2) demonstrate waste handling operations. As such, the proposed Test Phase has two distinct elements: 1) the Performance Assessment, and 2) the Integrated Operations Demonstration. These elements are currently under evaluation by the DOE based on comments from independent groups such as the Blue Ribbon Panel, the National Academy of Sciences, the Environmental Evaluation Group, and the Advisory Committee on Nuclear Facility Safety. At this time, the Performance Assessment tests would be comprised of laboratory-scale, bin-scale, and alcove-scale tests. The DOE, in December 1989, issued a revised draft final Test Phase plan that focuses on the Performance Assessment tests to remove uncertainties regarding compliance with long-term disposal standards (40 CFR 191 Subpart B) and to provide confirming data that there would be no migration of hazardous constituents. This plan specifies the source, type, and volumes for the initial Performance Assessment tests. The plan is currently undergoing review by NAS, EEG, EPA, and other key agencies. Waste requirements for the Integrated Operations Demonstration remain uncertain. A separate document would be

developed to describe in detail the Integrated Operations Demonstration following the DOE's decision as to the scope and timing of the demonstration.

During the Test Phase, the DOE proposes to transport to and emplace in the WIPP waste quantities limited to those deemed necessary to achieve the objectives of the Test Phase. For purposes of bounding the potential impacts of the Test Phase in this SEIS, the DOE assumes that up to 10 percent of the volume of TRU waste that could ultimately be permanently emplaced in the WIPP would be emplaced during the Test Phase. The actual amount of waste that would be used for the Test Phase is likely to be less than that assumed for purposes of analysis in this SEIS. It is similarly assumed for purposes of bounding the impacts that waste would be shipped from all 10 facilities, although it is now likely that only waste from the Rocky Flats Plant and the Idaho National Engineering Laboratory would be used during the initial phases of the proposed Test Phase.

The new information pertains mainly to the geologic and hydrologic systems at the WIPP site. The SEIS includes new data which indicate:

- The permeability of the Salado Formation, the geologic formation in which the WIPP underground facilities are located, is lower than previously believed.
- The moisture content of the Salado Formation and the consequent brine inflow is higher than previously believed.
- A higher transmissivity zone is present in the Rustler Formation in the southeastern portion of the WIPP site.
- "Salt creep" (convergence) in the repository occurs faster than previously believed.
- Pressurized brines within the Castile Formation are present beneath a portion of the WIPP waste-emplacement areas.
- Fractures have developed in the underground rooms previously excavated, attributable to more rapid convergence.

These new data are of concern mainly for the long-term performance of the repository, and they were used in conducting the analyses reported in this SEIS. Fracturing is of concern for the operational period. Therefore, mitigation measures such as rockbolting and wire meshing have been implemented to protect underground workers from rockfalls that could result from fractures.

In addition, the final SEIS provides information that describes the TRU waste retrieval and processing activities at representative DOE generator/storage facilities. Also provided are descriptions of the bin and waste preparation that would occur at the generator/storage facilities prior to the proposed Test Phase.

A draft of this SEIS was issued for public comment on April 21, 1989. During the 90-day comment period that followed, the DOE held nine public hearings at locations in Colorado, Georgia, Idaho, New Mexico, Oregon, Texas, and Utah. In addition to the testimony of nearly 1,000 individuals who spoke at the hearings, the DOE received 1,275 written documents and two petitions with a combined total of approximately 2,200 signatures. The DOE reviewed the comments, categorized them by issue, revised the draft SEIS as appropriate, and prepared a comment-response document (Volume 3 of this final SEIS) that presents synopses of the comments and the DOE's responses.

MAJOR ISSUES RAISED IN COMMENTS AND REVISIONS

The major issues raised in the comments and their resolution are discussed below.

Programmatic Issues and the Scope of the SEIS

A number of commenters said that the DOE's decisionmaking is fragmented because the TRU waste that was generated before 1970 is not within the scope of the draft SEIS and the Proposed Action as discussed in the draft SEIS addresses only waste from four of ten facilities that generate or store TRU waste. Related comments on the scope of the draft SEIS said that the SEIS should address all issues and decisions on defense TRU wastes, including the selection of an alternative site for the retrievable storage of waste from the Rocky Flats Plant, the selection of a site for storing TRU waste retrieved from the WIPP if retrieval is necessary, and potential requirements for waste treatment and their environmental impacts. In addition, some commenters said that the draft SEIS did not contain a sufficiently comprehensive discussion of the impacts of no action.

In response to these comments, Sections 1 and 3 of Volume 1 of the SEIS were revised to clarify that the Proposed Action is to proceed with a phased approach to the development of the WIPP to demonstrate the safe disposal of post-1970 TRU waste. The WIPP may eventually dispose of post-1970 TRU waste from up to 10 DOE generator/storage facilities. Section 1 was revised to explain the DOE's commitment to prepare environmental documentation for proposed waste retrieval and processing actions at all of the generating and storage facilities and for all major waste-management decisions, such as finding an alternative storage facility for Rocky Flats Plant TRU waste (which is not addressed by the Proposed Action of this SEIS) or requiring and providing facilities for waste treatment as a means of mitigating the long-term consequences at WIPP.

Subsection 3.1.1 was revised to better explain changes to the Proposed Action since the 1980 FEIS, including the objectives of the proposed Test Phase, and to discuss new information. To address impacts at other facilities, Subsection 5.2.1 was expanded to include a description of potential waste retrieval and processing at a number of facilities and to summarize the environmental impacts predicted for these activities at the Idaho National Engineering Laboratory, the Hanford Reservation, and the Savannah River Site, as representative of impacts likely to occur at the other facilities. A new appendix (Appendix P) on retrieval and processing was added to this final SEIS.

To provide more information about the tests planned for the modified Test Phase, the DOE prepared a new appendix (Appendix O). During the Test Phase, National Environmental Policy Act (NEPA) requirements would be reviewed in light of the new information developed and appropriate documentation would be prepared. In addition, the DOE will issue another SEIS at the conclusion of the Test Phase and prior to a decision to proceed to the Disposal Phase. This SEIS will analyze in more detail the system-wide impacts of processing and handling at each of the generator/storage facilities and will consider the system-wide impacts of potential waste treatments.

In addition, Subsections 3.2 and 5.5 were revised to amplify the discussion of the potential impacts of the No Action Alternative.

Compliance with EPA Regulations and RCRA Requirements

A number of commenters asked about the DOE's plans for demonstrating compliance with the radiation protection standards for disposal of TRU waste to be promulgated by the EPA in 40 CFR Part 191, Subpart B, and the requirements of the Resource Conservation and Recovery Act (RCRA).

Subsections 3.1.1.4 and 5.4 were revised to provide a better explanation of the DOE's plans for the performance-assessment program that is proposed to demonstrate compliance with the EPA disposal standards. A subsection was added to Appendix I to discuss the technical approach that is likely to be used in demonstrating compliance with the EPA disposal standards.

The above-mentioned new Appendix O also discusses that the experimental tests would provide information to confirm the demonstration of RCRA compliance. Additional information is provided in Chapter 10 concerning the no migration petition which the DOE has filed with the EPA to demonstrate that the WIPP is a proper disposal facility for waste regulated under the Land Disposal Restrictions.

Waste Volumes and Characteristics

Several comments requested better definition of the types and quantities of waste proposed to be shipped to the WIPP. Appendix B was revised and updated in response to these comments to clarify the discussion of waste volumes and characteristics.

Waste Retrieval

Some commenters asked about the plans for retrieval of waste emplaced in the WIPP during the Test Phase if the DOE decides not to proceed with the Disposal Phase of the Proposed Action. Subsection 2.5 was revised to show the steps that would be involved in the retrieval process.

Transportation

Transportation issues elicited more comments than any other subject. Many comments addressed compliance with the requirements of the U.S. Nuclear Regulatory

Commission (NRC) for the certification of the TRUPACT-II containers that would be used for shipping most of the TRU waste (i.e., the contact-handled waste) to the WIPP. Other concerns included emergency response to traffic accidents, qualification of the trucking contractor, transportation routing, and accident analysis methodology and assumptions.

To address many of the concerns raised in these comments, the DOE revised and expanded Subsection 3.1.1.3 and Appendix D.2 to clarify the description of the transportation program, including the TRUPACT-II containers that would be used to ship waste to the WIPP. The analyses of potential transportation impacts were also revised (see Subsections 5.2.2, Appendix D.3, and D.4). Among the revisions is a new analysis of the "bounding-case" transportation accident, incorporating some factors (e.g., maximum curie contents) suggested in comments.

The discussion of transportation emergency planning in Appendix C was substantially expanded and two new appendices were prepared. Appendix L describes the shipping containers and casks that would be used, and describes the requirements for NRC certification and includes a copy of the NRC Certificate of Compliance for the TRUPACT-II. Appendix M summarizes the management plan for the trucking contractor selected for the proposed Test Phase. The topics covered in this plan include safety, maintenance, driver qualification and training, normal transportation procedures, the vehicle-tracking system, and response to emergencies.

Operational Safety and Long-term Performance

In response to a number of comments, revisions were made to more clearly describe the WIPP environmental monitoring programs and the potential impacts of WIPP operations and the long-term performance of the repository after closure and decommissioning. These include: the addition of Subsections 2.9.4 and 2.9.5 which describe the DOE's Operational Environmental Monitoring Program and the monitoring program of the Environmental Evaluation Group (EEG), respectively; the addition of Subsection 4.3.2.4, which describes the disturbed-rock zone in the underground excavations and related concerns about worker safety; and the expansion of Subsection 5.2.3 and Appendix F to analyze a highly improbable but potentially severe accident involving a hoist drop. Although significant radiation releases from such a hoist drop accident are not considered to be a reasonably foreseeable event, the consequences were included in response to a specific comment by the EEG. The discussions of radiological safety during retrieval and of the potential consequences from the hazardous chemicals in the waste, including the discussions of chemical exposure and risk assessment in Appendix G (Subsections G.3 and G.4), were clarified where appropriate.

Appendix N was prepared to consider radiation-induced health effects estimates recently published by the National Academy of Sciences (NAS). It uses the calculational factors given in the BEIR-IV NAS report to reevaluate the health effects predicted for WIPP operations and presents an estimate of genetic effects. Finally, additional information about the safety of underground workers during and after the Test Phase (including retrieval if necessary) was provided in Appendix O. Subsection 6.2 was revised to

clarify the description of the mitigation measures that the DOE may use to minimize risks to workers and the general public.

For the assessment of long-term performance, additional data on the hydrologic properties of the Culebra aquifer were analyzed and the modeling of radionuclide transport was improved by incorporating a more realistic two-dimensional treatment; with these revisions, two extreme scenarios reported in the draft SEIS (cases IIA and IIC) were recalculated and a new scenario (Case IC) was added to examine the consequences of leaks past the seals. The results are presented in Subsection 5.4, and details of the revised analysis are given in Appendix I. In addition, the supporting geohydrologic information in Appendix E has been supplemented with more recently available material. Subsection 6.3 was revised to clarify the discussion of the mitigation measures that could be used to enhance long-term performance.

DESCRIPTION OF ALTERNATIVES

This SEIS analyzes three alternatives: the Proposed Action, the No Action Alternative, and an Alternative Action of conducting only those tests that can be performed without the emplacement of waste underground until compliance with EPA disposal standards for TRU waste has been demonstrated. The alternatives of either not conducting any tests with TRU wastes or conducting tests with simulated, nonradioactive wastes were considered and rejected as unreasonable because they would not remove uncertainties to permit the conduct of a performance assessment that would demonstrate compliance with EPA disposal standards.

Proposed Action

The Proposed Action is to proceed with a phased approach to the development of the WIPP to demonstrate the safe disposal of post-1970, defense generated TRU waste. A phased approach relative to construction and operation of the WIPP has been pursued since the start of the TRU-waste disposal program. Generally, this process began with site selection and characterization; proceeded through site design and validation to construction; would continue, with a Test Phase; and would conclude, if appropriate, with a Disposal Phase and decontamination and decommissioning. Pursuant to this phased approach, the DOE is now proposing the implementation of a Test Phase.

The proposed Test Phase would include bin-scale tests and alcove-scale tests to provide data for performance assessment. The bin-scale tests are being designed to provide information about gas generation, gas composition, and gas depletion rates as well as radiochemical source term data from actual CH TRU waste. CH TRU waste would be mixed in specially designed bins with backfill, brine, and salt to simulate conditions to which the waste would be exposed within the repository. The waste used would be representative of the TRU mixed waste inventory. Because of the potential uncertainties inherent in extrapolating laboratory or even bin-scale results to the full-scale repository, the DOE proposes to conduct alcove-scale tests in the WIPP repository to validate gas-generation models and predict impacts for realistic waste-inventory emplacements. Additional alcove-scale tests would be conducted with wastes modified

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Dear Friend:

Enclosed is a copy of the U.S. Department of Energy's (DOE) final Supplement to the Environmental Impact Statement (SEIS) for the Waste Isolation Pilot Plant (WIPP). The final SEIS was prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, as amended. The U.S. Department of the Interior, Bureau of Land Management, was a cooperating agency in its preparation.

In October 1980, DOE issued the WIPP Final Environmental Impact Statement (FEIS) (DOE/EIS-0026). The Record of Decision (ROD) (46 FR 9126, January 28, 1981) documented DOE's decision to proceed with the phased construction and operation of WIPP at the Los Medanos site near Carlsbad, New Mexico. On February 17, 1989, DOE announced its plans to prepare a supplement to the FEIS (54 FR 7251) and evaluate the environmental impacts associated with new information and changes in the proposed action since the ROD was issued. The new information and changes in the proposed action analyzed in the SEIS include changes in the transuranic (TRU) waste inventory, consideration of the hazardous chemical constituents in the TRU waste, modification and refinement of the system for the transportation of TRU waste to WIPP, modification of the Test Phase, and changes in the understanding of the hydrogeological characteristics of the WIPP site.

The SEIS evaluates and compares the Proposed Action and two alternatives. The Proposed Action is to proceed with a phased approach to the development of WIPP as a research and development facility to demonstrate the safe disposal of post-1970, defense-generated TRU waste. Full operation of WIPP would be preceded by a Test Phase of approximately five years during which time certain tests and an operations demonstration would be carried out. The elements of the Test Phase continue to evolve. The DOE, in December 1989, issued a draft final Test Phase plan that focuses on tests that would be conducted to reduce uncertainties associated with the prediction of natural processes that might affect long-term performance of the underground waste repository. Results of these tests would be used to assess the ability of WIPP to meet applicable Federal standards for the long-term protection of the public and the environment from disposal of TRU waste and to confirm compliance with Resource Conservation and Recovery Act (RCRA) Land Disposal Restrictions

and other regulatory requirements. The operations demonstration would be conducted to show the ability of the TRU waste management system to certify, package, transport, and emplace TRU waste in WIPP safely and efficiently.

Waste requirements for any operations demonstration remain uncertain. A separate document would be developed to describe in detail the operations demonstration following DOE's decision as to scope and timing of the demonstration. The DOE will issue another SEIS at the conclusion of the Test Phase and prior to a decision to proceed to the Disposal Phase.

The first alternative is the No Action alternative under which there would be no research and development facility to demonstrate the safe disposal of TRU waste, and TRU waste would continue to be retrievably stored. Storage of newly generated TRU mixed waste would be in conflict with RCRA Land Disposal Restrictions; treatment would be required to avoid such conflict. WIPP would be decommissioned as a waste disposal facility and potentially put to other uses. The second alternative is to conduct only those tests that can be performed without placing waste underground in WIPP until a determination has been made of compliance with the Environmental Protection Agency (EPA) standards for TRU waste disposal. The bin-scale tests would be conducted in a specially designed above-ground facility to be constructed at a DOE facility.

On April 21, 1989, DOE published the Draft SEIS and began a 90-day public comment period. In addition to receiving 1,275 written comment documents from individuals, groups, and agencies, DOE conducted public hearings in nine locations: Atlanta, Georgia; Denver, Colorado; Pocatello, Idaho; Pendleton, Oregon; Albuquerque, New Mexico; Santa Fe, New Mexico; Artesia, New Mexico; Odessa, Texas; and Ogden, Utah. The DOE has analyzed all relevant comments, revised the SEIS as appropriate, and prepared a comment-response document.

Copies of the Final SEIS are being provided to members of Congress; the Office of Management and Budget; the DOE Public Information Reading Rooms; many public libraries; and to agencies, organizations, and persons who requested copies. The ROD will be issued no less than 30 days following the announcement by EPA in the Federal Register of the availability of the Final SEIS.

Sincerely,

Bruce G. Twining
Manager

Enclosure

to simulate the impacts of the actual repository environment on the long-term degradation behavior of the wastes. The DOE is also considering an EPA suggestion to establish two full-scale waste rooms for monitoring purposes.

If, during the Test Phase, there were significant indication of the WIPP's inability to comply with the EPA disposal standards, a number of options would be considered (e.g., waste treatment, engineering modifications) for bringing the WIPP into compliance.

The need for additional NEPA documentation will be evaluated during the Test Phase. Prior to the Disposal Phase a new SEIS will be prepared.

At the conclusion of the Test Phase, the DOE would determine whether the WIPP would comply with the standards to be finalized by the EPA for the disposal of TRU waste (40 CFR Part 191, Subpart B). The tests would also provide data used to confirm compliance with RCRA Land Disposal Restrictions (40 CFR Part 268) and other applicable requirements. The WIPP would move into the Disposal Phase if there was a favorable Record of Decision based on the new SEIS to be prepared prior to the Disposal Phase and if there was a determination of compliance with the EPA standards and other regulatory requirements.

No-Action Alternative

The No Action Alternative was included among those alternatives considered in the FEIS of 1980. The FEIS analyzed the impacts of maintaining defense TRU waste in retrievable storage for an indeterminate period. The Record of Decision on the FEIS, which was published on January 28, 1981, determined, as part of the basis for decision, that the No Action Alternative was "unacceptable." This determination was made at the time because of the potential impacts of natural, low probability events and human intrusion at storage facilities after governmental control of the facilities is lost.

Under the No Action Alternative, TRU waste would not be shipped to nor emplaced in the WIPP for the Test or Disposal Phases. The WIPP potentially would be decommissioned or put to other uses as appropriate. TRU waste would continue to be retrievably stored by the DOE. To continue meeting the DOE's national defense and energy missions, the DOE would have to build treatment facilities meeting land disposal requirements for TRU mixed waste. The DOE has submitted a "no migration" petition to the EPA to demonstrate that the WIPP is a proper disposal facility for waste regulated under the Land Disposal Restrictions.

The FEIS and this SEIS analyze the environmental consequences of the No Action Alternative under several different assumptions and conditions. In general, it is estimated that if the DOE would provide effective monitoring and maintenance of storage facilities, adverse health effects for the general public would be quite small, and the principal adverse effects, also small, would be related to occupational activity at the facilities.

In summary, the No Action Alternative would continue the current practice of retrievable storage and would not result in the demonstration of the safe disposal of TRU waste.

Alternative Action

The Alternative Action is to conduct only those tests that can be performed without emplacing waste underground until compliance with EPA standards for disposal of TRU waste has been demonstrated. Of the tests proposed for the WIPP underground, only the bin-scale portion could reasonably be conducted at a location other than the WIPP underground. Thus, this alternative is essentially the same as the Proposed Action except for changes in the Test Phase. These tests would need to be conducted in a specially engineered aboveground facility that would be constructed for this purpose.

The objectives of the bin-scale tests under this alternative would be identical with those described under the Proposed Action. Bin-scale tests for this alternative could be accomplished at any one of several DOE facility locations. The Idaho National Engineering Laboratory was chosen as a representative facility for purposes of analyzing impacts that would generally be representative of impacts associated with bin-scale tests aboveground for any of these alternative locations. (It is not the DOE's intent to propose the Idaho National Engineering Laboratory as the facility for bin-scale tests, but simply to use it to illustrate representative levels of impact.)

Since the alcove-scale tests could not be performed practically or usefully at a location other than the WIPP underground, the results of the alcove-scale tests would not be available to increase confidence regarding extrapolation of laboratory and bin-scale results to a full-scale representative repository loading. Therefore, the uncertainty in the Performance Assessment would be greater than under the Proposed Action. If the uncertainty in the Performance Assessment should be unacceptable, the DOE would evaluate further courses of action.

Under the Alternative Action, the Integrated Operations Demonstration would not be conducted prior to the completion of the compliance determination. All other actions described in the Proposed Action would remain the same under this alternative, although some activities may be delayed.

Alternatives Considered but Not Analyzed

The DOE also considered the possibility of performing experiments in support of the Performance Assessment with simulated, nonradioactive waste. While this alternative would avoid potential effects associated with the use of radioactive waste during the Test Phase, it was determined to be unreasonable. For the confident evaluation of the effect of gases on the long-term behavior of the repository, it is necessary to use actual TRU waste to obtain relevant and sufficient data. Several different types of data regarding the behavior of TRU wastes are required. These include information about gas generation, gas speciation, and gas depletion rates as a function of time and of various waste conditions. The impacts of radiolytic, bacterial, and chemical corrosion degradation mechanisms can be adequately analyzed only in tests that use actual radioactive TRU waste. Finally, the synergisms, or complex interactions, between various ongoing in-situ processes can be effectively analyzed only when actual TRU wastes are used.

A variation of this alternative would be to proceed with the Performance Assessment with no tests using waste in the WIPP and no new construction for aboveground tests. This alternative is unreasonable for the reasons given above with respect to using simulated waste. In both cases, there would be too much uncertainty to permit conducting a Performance Assessment that would demonstrate compliance with the final 40 CFR Part 191, Subpart B requirements.

EXISTING ENVIRONMENT

The existing environment at the WIPP site is generally the same as described in the 1980 FEIS. However, the WIPP construction activities and studies conducted since the 1980 FEIS have generated additional environmental information for the WIPP site.

Since the publication of the FEIS, the economy of the WIPP site area has been depressed by declines in the oil, gas, and mining industries. Land use surrounding the WIPP site has not changed, but the release of approximately 11,000 acres in Control Zone IV would allow mineral exploration and development and permanent habitation where those activities were previously restricted.

ENVIRONMENTAL CONSEQUENCES

The environmental consequences presented in this SEIS are based on conservative assumptions and impact assessment methods designed to bound the potential consequences of WIPP operations. Impacts are presented for several components of WIPP operation: retrieval and processing, transportation, operations/retrieval, and long-term performance. A summary of the environmental consequences predicted for the Proposed Action, No Action, and the Alternative Action is given in Table S-1.

Retrieval and Processing

The impacts of retrieving and processing TRU waste from generator/storage facilities were assessed. It was determined that operational doses would be within DOE standards and that population doses from accidental releases would be small for the Proposed Action, Alternative Action, and No-action Alternative.

Transportation

Transportation impacts were assessed for potential TRU waste shipments from the ten generator and storage facilities. Impacts were assessed for waste transport by truck and by the "maximum rail" mode for both the Proposed and the Alternative Action.

Transportation under normal conditions. For the Proposed Action, the annual cumulative radiation dose received by the exposed public from truck shipments during the Test Phase (CH TRU waste only) was estimated to be 12 person-rem and during the Disposal Phase (CH TRU and RH TRU waste) would be 82 person-rem. These correspond to 0.003 and 0.02 excess latent-cancer fatalities in the entire exposed population. For rail shipments during the Disposal Phase (CH TRU and RH TRU waste),

the annual cumulative radiation dose to the exposed public would be 50 person-rem, which corresponds to 0.01 excess latent-cancer fatalities. For the Alternative Action, these estimated risks would be 0.02 and 0.01 excess latent-cancer fatalities for truck and rail transport, respectively.

The maximum radiation risks of contracting a fatal cancer due to annual exposures to the transportation of TRU wastes were estimated for a hypothetical maximally exposed individual member of the public under very conservative assumptions (e.g., working at a truck stop for 8 hours a day for 10 years and being exposed to the TRU waste shipments). For the Proposed Action, these risks were estimated to be 4.2×10^{-5} for truck shipments and 2.0×10^{-5} for rail shipments. Corresponding risks for the Alternative Action were estimated to be the same as for the Proposed Action.

Since the TRUPACT-II containers are not vented, no hazardous chemicals would be released during normal incident-free conditions. Therefore, no additional impacts are predicted because of these components.

Transportation accidents. The transportation accident analysis presented in this SEIS is based upon the best available nationwide average truck accident data (1.1×10^{-6} accident per kilometer). State-specific accident data obtained during the SEIS preparation are comparable.

For the truck shipment of TRU waste, the total nonradiological risks for the projected 25-year Test and Disposal Phases were estimated to be 7 fatalities and 92 injuries for the Proposed Action. The total nonradiological risks for rail transport for the Proposed Action were estimated to be 3 fatalities and 28 injuries. For the Alternative Action, the estimates were 7 fatalities and 92 injuries for truck shipment and 2 fatalities and 23 injuries for rail shipment. These projected deaths and injuries would result from the mechanical, not the radiological, effects of accidents.

The RADTRAN-II model was used to estimate the radiological risk to the public from transportation accidents. Radiological risks to the public were estimated for a range of accident scenarios with different probabilities of occurrence. For the Proposed Action, maximum annual radiological risks to the public for accident conditions for truck were estimated to be 1.6×10^{-3} excess latent cancer fatalities per year of operations for truck shipments and 7.6×10^{-4} excess latent cancer fatalities for rail shipments. Corresponding risks for the Alternative Action were estimated to be 1.7×10^{-3} excess latent cancer fatalities for truck shipments and 8.4×10^{-4} excess latent cancer fatalities for rail shipments. In addition, a "bounding case" scenario based on very conservative assumptions was developed and was used to estimate the impacts of a very severe accident. For this accident involving a truck hauling CH TRU waste, the number of excess latent-cancer fatalities was estimated to be 4.3 for shipments from the Los Alamos National Laboratory through a suburban area, 14 for shipments from the Savannah River Site through an urban area, and 16 for shipments from the Idaho National Engineering Laboratory through an urban area.

No adverse human health effects would be expected from exposure to the hazardous chemical components of TRU waste during a transportation accident. The two primary reasons for the lack of adverse impacts are the low initial concentrations of chemicals

in the waste and the physical form of the waste, which restricts the concentrations available for release.

Operations/Retrieval

The SEIS presents estimates of the risk from exposures to radiation and hazardous chemicals during normal WIPP operations and potential accident scenarios; risks for waste retrieval (if necessary) were also estimated. To compensate for uncertainties and to ensure that risks were not underestimated, conservative assumptions were used.

Normal operations. The annual occupational (worker) risks resulting from exposure to radiation during normal operations were estimated to be 0.0021 excess latent cancer fatalities during the Test Phase and 0.0047 excess latent cancer fatalities during the Disposal Phase. For the Alternative Action, the annual occupational risks resulting from exposure to radiation during normal operations were estimated to be 0.0052 excess latent cancer fatalities.

The annual radiological risks to the entire exposed public during the Proposed Action were estimated to be 1.3×10^{-7} excess latent cancer fatalities for the Test Phase and 3.1×10^{-7} excess latent cancer fatalities for the Disposal Phase. The radiological risks to the public for the Alternative Action were 3.4×10^{-7} excess latent cancer fatalities. The annual risk from waste retrieval, if necessary for the Proposed Action, was calculated to be 1.7×10^{-3} excess latent cancer fatalities and 3.3×10^{-11} excess latent cancer fatalities for the entire worker population and general public, respectively.

The analysis of risks from hazardous chemicals showed that no health effects would be expected in the general public from releases either during normal operations or accidents. The highest total cancer risk (1.6 chances in 1 million) from chemicals would be experienced by workers in the underground repository.

Accidents. The excess risk of fatal cancer to the maximally exposed individual after the most severe postulated accident at the WIPP is 4.8 in 10,000 for both the Proposed Action and the Alternative Actions. If credit is taken for high-efficiency filtration, the risk drops by 1 million times. During a severe accident affecting workers, an individual worker would incur an estimated excess risk of up to 17 chances in 10,000 of contracting a fatal cancer.

The maximum predicted hazardous-chemical intake by a worker resulting from an accident is approximately 10,000 times lower than the "threshold limit value" established by Federal agencies and 1,000 times lower than the value considered to pose an "immediate danger to life and health." Exposures received by the public from onsite accidents would be less than those received by workers and therefore would also be well below health-protection reference levels.

Socioeconomic Effects

For the Proposed Action, the annual economic impact in southeastern New Mexico for the Test Phase would range from about $150 to $185 million (in constant 1990 dollars)

a year. Direct employment would be between 650 and 660 jobs, and the annual total employment would be 1,650 to 1,800 jobs.

The annual funding for disposal under the Proposed Action is $67 million in constant 1990 dollars. The economic impact in southeastern New Mexico is expected to total $160.5 million a year, and persist at this level until a 5-year period of decommissioning would begin in 2013. Direct and indirect employment would average about 680 and 930 jobs, respectively, for a total of 1,610 jobs. Personal income would increase by $43 million a year from all sources. For the period from FY 1990 through 2018, WIPP funding would be over $2.1 billion in constant 1990 dollars. The total effect on the regional economy would be more than $4.3 billion.

Under the Alternative Action, WIPP funding for the next five years would decrease by $80 to $90 million annually, and significant decreases in the number of jobs would follow until disposal starts at the WIPP.

For disposal, the Alternative Action would require additional resources to handle the higher rates of waste receipt and emplacement. These resources would cost $104 million over the 20 years. The net effect, additional costs minus net funding reductions of about $85 million, would be $19 million in constant dollars.

Long-term Performance

The SEIS evaluates potential long-term impacts from the Proposed Action under two basic sets of assumptions. Case I examines the expected performance of an undisturbed repository, whereas Case II examines the performance of a repository disturbed by a borehole that penetrates through the repository into a pressurized-brine reservoir below. Variations of these cases were also examined to establish a range of impacts.

Case IB differs from Case IA (expected performance) in that some parameters are less favorable, including the solubilities of the radionuclides, which are assumed to be 100 times larger, and the resistance to flow in the shaft and panel seals, which is assumed to be 100 times lower. Thus, the contaminated brine would meet less resistance to flow.

Case IC was added for the final SEIS to evaluate continuing concerns about the extent of the disturbed-rock zone around tunnel and shaft seals. In this scenario, leakage through Marker Bed 139 past the accessway seals is presumed to increase their permeability by another factor of 10 beyond the value assumed in Case IB. And leakage through the disturbed rock is presumed to increase the permeability of the lower shaft seal by a factor of 100 beyond the value assumed in Case IB.

The estimates for the representative conditions of Case IA and unfavorable conditions of Case IB indicate that no radionuclides or lead would be released to the Culebra aquifer in 10,000 years and therefore there would be no pathway to humans during this 10,000-year period. In the extreme conditions assumed for Case IC, radionuclides would reach the aquifer in 400 years, but then would travel very slowly and would not result in human exposures until well after 10,000 years.

Four versions of Case II (borehole intrusion) were examined. Case IIA examines expected repository performance; Cases IIB, IIC, and IID incorporate various combinations of less favorable waste characteristics, less favorable groundwater flow conditions, and predisposal waste treatment. In each case, it was assumed that a drillhole is inadvertently drilled into and through the repository down to an underlying brine reservoir in the Castile Formation and later plugged with grout. When the borehole plugs fail, Castile brine would start to flow up the borehole to the Culebra aquifer. The upward flow would be slow enough that brine would become saturated with waste radionuclides and lead. In addition, the brine from the surrounding Salado salt would be mixed with brine from the Castile reservoir and move up with it to the Culebra. The radionuclides and lead that would reach the Culebra aquifer would flow to the south with the Culebra water but would be retarded to various degrees by sorption in the rock through which they would pass. Culebra water in a hypothetical stock well was assumed to be drunk by cattle. This well was assumed to be 3 miles south of the WIPP site. The human exposures would be the doses received by a person who gets his or her entire meat supply from those cattle. The doses estimated are the maximum doses that the beef eater would receive during the first 10,000 years after the drillhole is plugged. Active institutional controls are assumed to prevent this intrusion earlier than 100 years after the WIPP is decommissioned. Thus the amount of radioactivity in the repository when borehole brine is assumed to interact with it is reduced very little by radioactive decay, and the calculations only allow for radionuclide decay thereafter during the waterborne transport to the stock well.

For the final SEIS, a new analysis of Cases IIA and IIC was performed with an improved version of the SWIFT II code that allowed an explicit treatment of the two-dimensional nature of flow and transport in the Culebra. These two cases were chosen for recalculation because they are the extremes of the scenarios in Case II. Cases IIA (rev) and IIC (rev) include lateral-dispersion effects, species-specific diffusion, and a revised Culebra flow field.

The maximum estimated doses range from 0.000001 millirem for Case IIA(rev) to 28 millirem for Case IIC (rev). These doses are the 50-year committed doses incurred from 1 year's ingestion of beef. Lead exposure for Case IIC (rev) is estimated to be less than 0.01 of the allowable daily intake and exposure from Case IIA (rev) is less.

Integrated releases

Compliance with the EPA standards for the WIPP will be determined by calculating "integrated releases" for a large number of release scenarios. The term "integrated release" is defined by the EPA as the total cumulative release over the full width of the contaminant plume for a period of 10,000 years. Two calculations of releases past the site boundary have been made for this SEIS, for Cases IIA(rev) and IIC(rev). These estimates were obtained with a computer code that includes lateral dispersion, species-specific diffusion, and the revised Culebra flow field. It is a fully two-dimensional code that explicitly treats the lateral spread of the contamination.

The EPA requires that evaluations of compliance with the standard take into account the probability of release. Such evaluations are based not on a single calculation but

on many calculations, each with an associated probability. The results are combined into a "complementary cumulative probability function," a statistical curve that indicates the probability of exceeding various levels of cumulative release.

The two SEIS calculations are considered here apart from their probabilities of occurrence. The releases are expressed relative to the limit in the standard (i.e., results less than 1.0 indicate releases that are within the limit).

The integrated releases for Cases IA, IB, and IC are all zero; no radioactivity gets to the site boundary within 10,000 years if the site remains undisturbed. In Case IIA(rev), the resulting integrated release is 1.7×10^{-6} at the WIPP site boundary. In Case IIC(rev), the normalized sum of radionuclides is 3.17 at the site boundary.

Case IIC(rev) deliberately postulates a near-extreme set of inputs, and the combinations of conditions required for the calculated releases have a low probability of occurring. On the other hand, the result with a high probability (the expected integrated release calculated for Case IIA[rev]) is almost a million times lower than the limit specified by the EPA standard. The vast difference between these releases suggests that most of the individual calculated integrated releases will be much smaller than the estimate for Case IIC(rev). One of the purposes of the proposed Test Phase is to collect data needed to reduce uncertainties associated with the prediction of natural processes that might affect the long-term performance of the underground waste repository.

MITIGATION MEASURES

Since the construction of the WIPP surface facilities, the shafts and much of the underground repository have been completed, and a number of mitigation measures have already been implemented. Measures that can help protect the workers and the public during operations have been identified. These measures are applicable to both the Proposed and Alternative Actions because they can be used both during testing and during disposal operations.

Excavation of underground rooms at the WIPP has resulted in fracturing of the surrounding rock, creating a disturbed-rock zone (DRZ)--a volume of rock whose mechanical properties (e.g., the elastic modulus) and hydraulic properties (e.g., permeability and fluid inflow) have been changed by mining. DRZ fractures which could create unsafe working conditions and make retrieval more difficult are mitigated by ground control measures including rock bolting and wire meshing. The DRZ may also provide pathways through which fluid can bypass the tunnel and shaft seals. Fluid movement around seals may be mitigated by excavating around the disturbed rock zone and by immediately emplacing the seal before the rock has an opportunity to fracture to a large extent. Similarly, fluid movement around seals within an underlying anhydrite layer (Marker Bed 139) may be mitigated by excavating the anhydrite layer, emplacing seals, and grouting around it.

The mitigation of brine inflow may involve the emplacement of selected backfill materials to sorb brine, and sealing possible routes (panel and shaft seals) through which brine could migrate to the shafts and upward to the Culebra water-bearing zone. Backfill

materials under consideration include crushed salt or a mixture of salt and bentonite. Additives that remove gases by absorption may also be mixed with the backfill.

The FEIS recognized the need to plug remaining holes and shafts when the WIPP is being decommissioned. Current plans are to seal all holes and shafts in order to eliminate the pathways where waste material might migrate to the overlying Culebra water-bearing zone or even the ground surface. A number of tunnel seals are now planned to isolate the different parts of the underground facility from the shafts. Tunnels would be sealed following waste emplacement with preconsolidated crushed salt. Salt-bentonite layers would be laid where the shaft intersects anhydrite beds. All other intervals in the Salado Formation would be filled with salt. In the Rustler Formation, a complex set of concrete and salt-bentonite sections is being considered to seal that formation's numerous water-bearing beds.

To prevent or alter certain waste characteristics that are not desirable, various methods of waste treatment could be used. The methods for treating TRU waste that could be required to improve the long-term performance of WIPP are immobilization, incineration, and compaction. All the methods would reduce the volume, solubility , and leachability of the waste. The reduction of volume reduces the rate of gas generation because it hinders brine access. The reduction of solubility and leachability reduces the potential for radionuclide migration from the repository. The desirability of requiring treatment of the waste to be emplaced at the WIPP would be evaluated during the Test Phase.

TABLE S-1 Summary and comparison of environmental consequences[a]

Environmental component	Proposed Action	No Action	Alternative Action
Vegetation and Wildlife	Same or less than those described in 1980 FEIS[b]. Temporary disturbance of wildlife and vegetation during decommissioning of WIPP.	Temporary disturbance of wildlife and vegetation during decommissioning of the WIPP.	During Test Phase, less than 0.25 acre of land disturbance at other DOE facility; very little effect on vegetation and wildlife; Disposal Phase consequences would be the same as for the Proposed Action. Temporary disturbance of wildlife and vegetation during decommissioning of the WIPP.
Socioeconomics	Maximum direct and indirect employment of 1610 during Disposal Phase; total economic impact of $4.3 billion through decommissioning.	Reduction in WIPP employment with corresponding economic impact to regional economy.	Maximum direct employment of 11 at other DOE facility during bin-scale tests with no appreciable economic impact; maximum reduction in WIPP employment of 145 during conduct of bin-scale tests with corresponding economic impacts.
Cultural Resources	No impacts anticipated during Test and Disposal Phases.	No impacts anticipated.	No impacts anticipated during the Test and Disposal Phases.
Land Use	Same as those described in 1980 FEIS except that approximately 10,000 acres would remain available for unrestricted use[c]; approximately 50 million tons of potash resources would remain available for extraction.	Over 10,000 acres at WIPP site would be returned to previous status and use; hydrocarbon and potash resources available for extraction.	No appreciable impacts at other DOE facility for bin-scale tests; same as those for Proposed Action at WIPP during the Disposal Phase.
Air Quality	Same as those described in 1980 FEIS[d]. Temporary decline in air quality during decommissioning of WIPP.	Temporary decline in air quality during decommissioning of the WIPP.	Temporary decline in air quality at existing DOE facility during facility construction for bin-scale tests; potential release of small amounts of radionuclides during bin-scale tests; same as those for the Proposed Action at WIPP during the Disposal Phase. Temporary decline in air quality during decommissioning of the WIPP.
Waste Retrieval and Processing from DOE Facilities	Routine operational doses within DOE standards; population doses from accidental release would be significantly less than background.	Waste retrieval and/or processing would occur as required for safe retrievable storage. Waste treatment may be required to comply with the RCRA Land Disposal Restrictions. Routine operational doses within DOE standards; population doses from accidental release would be significantly less than background.	Impacts during the Disposal Phase would be the same as described in the Proposed Action.

TABLE S-1 Continued

Environmental component	Proposed Action	No Action	Alternative Action
Transportation			
I. Physical Accidents and Vehicle Emissions			
Truck	7 fatalities and 92 injuries	Minimal risk[e]	7 fatalities and 92 injuries
Rail[f]	3 fatalities and 28 injuries	Minimal risk	2 fatalities and 23 injuries
II. Radiological Risk to Public[g]			
Routine Transport[h]			
Truck	2×10^{-2}	Minimal risk	2×10^{-2}
Rail	1×10^{-2}	Minimal risk	1×10^{-2}
Accident Conditions			
Truck	1.6×10^{-3}	Minimal risk	1.7×10^{-3}
Rail	7.6×10^{-4}	Minimal risk	8.4×10^{-4}
Hypothetical Maximally Exposed Individual			
Truck	4.2×10^{-5}	Minimal risk	4.2×10^{-5}
Rail	2.0×10^{-5}	Minimal risk	2.0×10^{-5}

TABLE S-1 Continued

Environmental component	Proposed Action	No Action	Alternative Action
III. Chemical Risks to Public			
Routine Transport			
Truck	No exposure	No exposure	No exposure
Rail	No exposure	No exposure	No exposure
Accident Conditions			
Truck	Minimal exposure	Minimal risk	Minimal exposure
Rail	Minimal exposure	Minimal risk	Minimal exposure
Operations/Retrieval[i]			
I. Public Health (Routine Operations)			
Radiological Risks[g]	3.1×10^{-7}	Minimal risk[j]	3.4×10^{-7}
Carcinogenic Chemical Risks	Minimal risk	Minimal risk[j]	Minimal risk
Noncarcinogenic Chemical Risks	Minimal risk	Minimal risk[j]	Minimal risk
Public Health (Operational Accidents)			
Radiological Risks[g,k]	4.8×10^{-4}	Minimal risk[j]	4.8×10^{-4}
Carcinogenic Chemical Risks	Minimal risk	Minimal risk[j]	Minimal risk
Noncarcinogenic Chemical Risks[l]	Minimal risk	Minimal risk[j]	Minimal risk

TABLE S-1 Continued

Environmental component	Proposed Action	No Action	Alternative Action
Operations/Retrieval Continued			
II. Worker Health (Routine Operation)			
Radiological risk[g]	4.7×10^{-3}	Minimal short-term risk[j]	5.2×10^{-3}
Carcinogenic Chemical Risks[m]	1.2×10^{-5}	Minimal short-term risk[j]	1.2×10^{-5}
Noncarcinogenic Chemical Risks[h]	1.8×10^{-3}	Minimal short-term risk[j]	1.8×10^{-3}
Worker Health (Operational Accidents)			
Radiological Risks[i]	1.7×10^{-3}	Minimal short-term risk[j]	1.7×10^{-3}
Carcinogenic Chemical Risks[l,m]	1.7×10^{-4}	Minimal short-term risk[j]	1.7×10^{-4}
Noncarcinogenic Chemical Risks[l,n]	1.1×10^{-4}	Minimal short-term risk[j]	1.1×10^{-4}

TABLE S-1 Continued

Environmental component	Proposed Action	No Action	Alternative Action
Long-term Performance		No permanent repository selected; wastes remain in storage; off-site exposures could result from various natural disruptive events and/or human intrusion[k]	
Case I: undisturbed repository (expected and degraded conditions)	No resulting exposure within 100,000 years	NA[o]	Same as Proposed Action
Case II: repository intrusion			
Drill crew: maximum exposure to worker	0.077 mrem[p] from CH TRU waste; 91 mrem[p] from RH TRU waste; (decaying to 2.8 mrem[p] in 180 years)	NA	Same as Proposed Action
Nearby ranch (from resuspension of dried mud pit particles)	0.77 mrem[p] per year of exposure from CH TRU waste, 0.38 mrem[p] from RH TRU waste; lead intake 1×10^{-9} of allowable daily intake	NA	Same as Proposed Action
Human consumption of contaminated beef			
Expected case (Case IIA [rev])	0.000001 mrem[p] per year of exposure; lead intake of 3×10^{-8} of allowable daily intake	NA	Same as Proposed Action
Degraded conditions with no mitigation (Case IIC [rev])	28 mrem[p] per year of exposure; lead intake 0.01 of allowable daily intake	NA	Same as Proposed Action

[a] From Section 5 of the SEIS

[b] FEIS Subsections 9.2.1 and 9.3.1.

[c] FEIS Subsections 8.1 and 9.2.3. Land and minerals remain available due to release of Control Zone IV.

[d] FEIS Subsection 9.3.1.

[e] No Action and decommissioning of the WIPP site would result in minor impacts accociated with the removal of certain equipment and supplies to other, unspecified locations as would the Proposed and Alternative Actions at the end of operations. Additionally under the No Action alternative, no waste transport to WIPP would occur. Consequences of waste transport to storage facilities would continue.

[f] The Proposed Action assumes 10 percent of the CH TRU waste is tranported by truck during the Test Phase with all of the remaining TRU waste being transported by rail (to the maximum extent possible) during the Disposal Phase. The usage of trucks results in higher impacts for the Proposed Action relative to the Alternative Action (100 percent by rail to the maximum extent possible).

[g] Radiological risks are expressed as excess latent cancer fatalities in the general population per year of operation. Reported values are the maximum annual of the Test Phase, retrieval, if applicable, and the Disposal Phase.

[h] Both CH TRU and RH TRU waste shipments are included.

[i] Retrieval refers to the retrieval of waste emplaced in the WIPP after the completion of the Test Phase, if required.

[j] Leaving waste in storage at generator/storage facilities would require site specific radiological and chemical impact analyses.

[k] For operational accidents, radiological risks are for the maximally exposed individual.

[l] For each accident event, the maximum hazard index is at least three orders of magnitude less than unity. If hazardous chemicals were to be conveyed to the hypothetical individual at the site boundary as a result of atmospheric dispersion of any of the on-site accident releases, the dilution in the vastly increased air volume (coupled with the increased diffusion) would produce expected hazard index ranges which had maximum values even less than the already insignificant hazard indices estimated for the on-site worker.

[m] Incremental lifetime cancer risk (also referred to as excess cancer risk) is defined as the estimated increased risk that occurs over an assumed average lifespan of 70 years as the result of exposure to a specific known carcinogen. Thus, an incremental lifetime cancer risk of one in a million (1×10^{-6}) may be interpreted as an increase in the baseline cancer incidence from 280,000 per million population to 280,001 per million population.

[n] Risks associated with noncarcinogens are presented in terms of hazard indices. The estimated daily intakes of the various receptors are divided by the acceptable reference levels. Hazard indices of less than unity indicate acceptable levels of exposure relative to these reference levels.

[o] NA = not applicable, since under No Action the WIPP would not be used for TRU waste disposal; therefore, no repository release or subsequent exposure could occur.

[p] 50-year committed effective dose equivalent.

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